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मानक

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IS 14417 (1996): Bulk handling equipment - Single boom slewable stacker - Rail mounted - Design, manufacture and erection - Code of practice [MED 7: Material Handling Systems and Equipment]



“ज्ञान से एक नये भारत का निर्माण”

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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrihari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

राशि प्रहस्तन उपस्कर — एक बूम वाले धुमाऊ स्टैकर —
रेल आरोपित — डिजाइन, निर्माण और स्थापना —
रीति संहिता

Indian Standard

**BULK HANDLING EQUIPMENT — SINGLE
BOOM SLEWABLE STACKER — RAIL
MOUNTED — DESIGN, MANUFACTURE
AND ERECTION — CODE OF PRACTICE**

ICS 53.080

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Bulk Handling Systems and Equipment Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

In industries such as steel, thermal power, cement, etc, uniform quality of the raw material plays an important role in the quality of the product and also for the optimum operation of the plant. The raw material is therefore first stacked, blended and then reclaimed for feeding to the plant for further processing. Stacking is done by stackers. Single boom slewable stacker is a type of stacker used for this purpose.

Stacker consists of a system of belt conveyors and extendable boom through which material is stacked in the form of heap. The pile of the material may consist of the same material but in different size or may consist of different material depending upon requirements. The stacked material is then reclaimed by reclaimer and loaded onto the conveyor system for feeding to the plant.

For the purpose of deciding whether a particular requirement of this standard is complied with, final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

BULK HANDLING EQUIPMENT — SINGLE BOOM SLEWABLE STACKER — RAIL MOUNTED — DESIGN, MANUFACTURE AND ERECTION — CODE OF PRACTICE

1 SCOPE

This standard covers mechanical, structural, electrical, inspection and testing requirements relating to design, manufacture and erection of rail mounted slewable stackers.

2 REFERENCES

The Indian standards listed in Annex A are necessary adjuncts to this standard.

SECTION 1 MECHANICAL AND STRUCTURAL REQUIREMENTS

3 DESIGN REQUIREMENTS OF SLEWABLE STACKER MECHANISM

3.1 General

3.1.1 The main constituents of the stacker consists of :

- a) Drive Mechanism:
 - 1) Long travel mechanism,
 - 2) Discharge boom conveyor drive mechanism,
 - 3) Discharge boom — slew mechanism,
 - 4) Boom luffing arrangement,
 - 5) Lubrication arrangement,
 - 6) Rail clamp mechanism, and
 - 7) Power and control cable reeling drum.
- b) Long travel arrangement;
- c) Under carriage;
- d) Upper revolving part;
- e) Tower structure/pylon;
- f) Discharge boom;
- g) Counterweight boom;
- h) Machinery house;
- j) Operator's cabin;
- k) Tripper car;
- m) Communication and controls;
- n) Auxiliary and accessories;
 - 1) Dust control system, and
 - 2) Counterweight

3.1.2 The slewable stacker shall be designed to take care of main, additional and special loads in accordance with IS 13148 : 1991

3.1.3 The stacker shall be designed and manufactured to take care of the height, width and centre distance of stockpile(s) of specified parameters required by the user.

3.1.4 The material of construction of the various parts of the stacker shall be suitable to handle the material specified.

3.1.5 *Safety Against Overturning*

The safety against overturning shall be in accordance with 11 of IS 13148 : 1991

3.1.6 *Safety Against Drifting*

Safety against drifting shall be in accordance with 12 of IS 13148 : 1991

3.1.7 *Safety Against Movement Due to the Wind*

Independent of the stability against overturning, a check shall be made that the stacker cannot be set in motion by maximum wind increased by 10 per cent. This check shall be carried out assuming a coefficient of friction equal to 0.14 for braked wheels and a resistance to rolling of 35 N/10 kN for unbraked wheels mounted on anti-friction bearings or of 100 N/15 kN for bushed wheels. For the design of clamps, the co-efficient of friction between the clamps and the rail shall be taken as 0.25.

3.2 Operating Requirements

3.2.1 Where so specified/required, the operation of the various controls shall be automatic/semi-automatic/manual. Programmable logic controls (PLC) are recommended for automatic and semi-automatic mode of operation. However, in all cases, manual override facility shall be provided. All operations of the stacker including its long travel shall be controlled from the operator's cabin. Local push button stations shall be provided near all drives for repair and maintenance.

3.2.2 The operator's cabin shall be pressurised so as to prevent ingress of dust for which a minimum water pressure of 5 mm water guage shall be maintained inside the cabin. Keeping in view the operator's comfort, 15 air changes per hour shall be provided inside the cabin.

3.2.3 Dust control system shall be provided so that the dust exit to atmosphere shall not exceed 150 mg/m³ or the maximum statutory provisions for pollution control, whichever is less. The dust so collected shall be fed back to the conveyor system of the stacker.

3.2.4 In case of wind velocity exceeding 72 km/h, an audio-visual signal shall be given by the anemometer. At 90 km/h, the total power shall be cut off and automatically, the rail clamps along with brakes shall get operated and applied to all motions.

3.2.5 All drive limit switches shall be provided with additional back up switches and all brakes shall be fail safe type.

3.2.6 Provision shall be made to provide two way communication between the stacker operator and central control desk. If so specified, suitable communication system shall also be provided between the stacker operator and local personnel.

3.2.7 Smoke detectors and fire extinguishers shall be provided at suitable locations.

3.2.8 Adequate illumination shall be provided near all drives, working/maintenance area of the machine, material discharge points, MCC rooms, platforms and walkways, staircases, ladders etc, to enable operation/maintenance of the equipment. Sufficient number of emergency lights shall be provided at control room, exit points, ladders, etc. so that during power failure essential activities like switching off the controls and exit of personnel is possible.

4 DRIVE MECHANISM

4.1 Long Travel

4.1.1 The stacker shall be carried on double flanged track wheels arranged for uniform distribution of loads. The travel motion shall comprise requisite number of motors, suitably synchronised. Each corner of the stacker shall be provided with resilient buffers to absorb the impact.

4.1.2 Safety stops shall be fitted on the rail tracks to limit the travel in addition to limit switches provided.

4.1.3 Minimum 50 percent of wheels on both sides shall be driven. Rail sweeps to clear rails shall be

provided in front of outer wheels. Buffers shall be provided on both sides of the carriage.

4.1.4 Jacking pads shall be provided for removal and changing of the wheels.

4.1.5 The rail gauge shall be decided after taking into consideration the technical parameters, design and the suitability of the machine.

4.2 Boom Conveyor

The conveyor system for boom conveyor shall generally be designed in accordance with IS 11592 : 1985 taking operator's conditions into account.

4.3 Boom Luffing

The luffing of the cantilever discharge boom shall be with the help of winches/hoists/ hydraulic arrangements. A positive limiting device shall be provided such that the luffing movement of the boom shall not have overrun.

4.4 Operator's Cabin

4.4.1 Operator's cabin with all necessary controls for performing the various operations shall be located in such a manner as to ensure complete view of the operations. Equalizing arrangements, if required, for cabin may be gravity hanging type or hydraulically operated.

4.4.2 The cabin shall be of adequate size to permit entry of and house all the required control equipment and may contain ample room for its adjustment and repair.

4.4.2.1 Control facilities for the following shall be provided in the cabin:

- a) Stacker travel,
- b) Trolley travel,
- c) Cabin lighting,
- d) Dust control system, and
- e) An emergency stop button to switch 'off' all loader motions. This shall not interrupt power to the auxiliary circuits, lighting, signals, etc.

4.4.3 Indicators and alarm for main supply, control supply, motions, wind pressure, phase failure, etc, shall be provided in the operator's cabin.

4.4.4 The cabin shall be provided with glazed windows on all sides to give operator an unobstructed view of the operations. Electrically operated wipers for the glass windows shall be provided to improve visibility during rains.

4.4.5 The cabin shall be furnished with sufficient facilities for comfortable seating of the operator with height adjustment. The cab shall be fully insulated and shall be equipped with wall mounted

electric motor driven ventilating fan with gravity type louvers (*see also* 3.2.2 and 8.1).

4.4.6 A signal horn controlled from the operator's cabin shall also be provided on the stacker.

5 GENERAL REQUIREMENTS

5.1 A machinery house accommodating drive mechanisms for operating trolley travel, boom luffing and electrical equipment like switch gears, motor control centre, transformer, etc, shall be provided. Adequate space for maintenance and also maintenance facilities like hoist shall be provided inside machinery house.

5.2 Wire Ropes and Rope Drums

Wire ropes shall conform to IS 2266 : 1977 and shall be of best plough steel. Factor of safety shall be as per IS 3177 : 1977.

5.3 Bearings

All bearings shall be protected against dust and grit. Allowance shall be made for impact and side thrust. Wherever necessary, spherical seatings and separate thrust bearings of suitable dimensions shall be used. Antifriction bearing used shall have minimum life of 50 000 working hours.

5.4 Couplings

Flexible couplings shall be of steel or cast iron of suitable grade to withstand transmission of maximum torque developed and shall be sized/selected accordingly. For boom conveyor, high speed coupling shall be fluid coupling in case of motor rating of 30 kW and above.

5.5 Shafts

5.5.1 Shafts and axles shall have sufficient strength, rigidity and adequate bearing surfaces. Shafts subjected to cyclic loading shall be designed for fatigue life also.

5.5.2 All shafts shall be made of carbon or alloy steel. Keyways and splines shall conform to relevant Indian Standards.

5.6 Gears and Gearboxes

Gears in power operated motion shall be machine cut/ground and shall conform to relevant Indian Standards. Gear boxes shall have built in lubrication system either splash or forced type.

5.7 Track Wheels

5.7.1 Track wheels may have cylindrical or tapered (conical) treads, with flanges or any other means as and where necessary, to guide the stacker effectively and to prevent derailment. The wheels shall be mounted in such a manner as to facilitate removal and replacement.

5.7.2 The track wheels shall be of steel (cast or forged) or have steel tyres shrunk on and registered. The steel of track wheels shall not contain more than 0.060 percent either of sulphur or of phosphorous. The wheel shall be suitably hardened.

5.7.3 Rail Wheel Size

5.7.3.1 To determine the size of rail wheel, the following checks shall be made:

- That it is capable of withstanding the maximum load to which it shall be subjected; and
- That it shall allow the appliance to perform its normal duty without abnormal wear.

5.7.3.2 Diameter of wheels

The tread diameters of wheels shall preferably be standardised to sizes specified in IS 1136 : 1990 commencing at 150 mm, in order of preference specified therein.

5.7.3.3 The minimum tread diameter of the wheel may be calculated from the formula given below:

$$D = \frac{2W}{a}$$

where

D = tread diameter of wheel in mm,

W = wheel load in kg, and

a = full width of rail head (face to face) including radii in mm.

5.7.4 Flanges

The dimensions of flanges of track wheels shall be not less than the values given in Table 1. The thickness of flanges of non-guiding wheels, if flanged, may be less than the values given in Table 1 as may be determined by the stacker manufacturer.

Table 1 Flange Dimensions

All dimensions in millimetres.

Diameter of Wheels	Depth of Flange	Thickness of Guiding Wheel at Flange Base
(1)	(2)	(3)
Up to and including 300	15	15
Over 300 and including 500	20	20
Over 500 and including 1 000	25	25
Over 1 000	30	30

5.8 Bolts, Nuts, Screws and Washers

5.8.1 All bolts and set screws in rotating parts shall be avoided. Bolts in tension shall be avoided wherever possible.

5.8.2 Tapered washers and tapered pads shall be provided on underside of steel sections with tapered flanges and shall be tack welded in place.

5.8.3 All bolts and nuts shall preferably be in accordance with IS 1364 (in five parts) and IS 1367 (in eighteen parts). Black bolts and nuts shall not be used. Alternatively friction grip fitted bolts may be used, where necessary, for proper assembly.

5.8.1.3 Washers shall conform to IS 2016 : 1967, IS 5372 : 1975 and IS 5374 : 1974 as appropriate.

5.9 Brakes, Rail Clamps and Anchors

5.9.1 Electro-mechanical (electro-magnetic)/electro-hydraulic brakes of adequate capacity shall be provided for all motions/motors in addition to emergency brakes for hoist hold and hydraulic rail clamps. All brakes shall be of fail safe type. Smooth braking shall be ensured for hoisting and trolley travel.

5.9.2 Rail clamps shall be provided and they shall be capable of holding the stacker in position during maximum wind velocity under storm conditions.

5.9.2.1 The brakes shall come in automatic operation from the anemometer.

5.9.2.2 For design of clamps, a coefficient of friction between the clamp and rail shall be taken as 0.25.

5.9.2.3 Electrical rail clamps shall automatically clamp whenever the power supply to the LT motors of the ship loader is cut off.

5.9.3 In addition anchoring device shall be provided to positively arrest the travelling motion of the stacker under storm conditions.

5.9.4 In case of winch operated luffing arrangements, boom luffing brakes shall be capable of taking 150 percent of respective full load motor torque.

5.10 Tripper Car

5.10.1 Suitable tripper car with discharge and feed pulley, idlers, travel wheels, etc, shall be connected to the main structure of stacker by means of hinged connection.

5.10.2 Discharge chute shall be provided with required liners. Care shall be taken to avoid

fouling of discharge chute with the skirt board provided on the boom conveyor during luffing motion of the boom.

5.10.3 The feeding arrangement from the tripper shall be to suit the following requirements:

- to feed full material on the boom conveyor;
- to completely pass the boom conveyor so that material can be fed to the same yard conveyor, or
- to feed part of material on to the boom conveyor and the balance to the stockyard using flow diverter.

6 STEEL STRUCTURES

6.1 The undercarriage, upper revolving part, discharge boom, pylon counterweight, boom and structure shall be designed to take care of the operational requirements including ease of access and maintenance. The members of the structure shall be designed in accordance with IS 13148 : 1991 to take care of prevalent environment conditions.

6.2 Safe means of access shall be provided to the operator's cabin and to every place where any person engaged on the inspection, repair and lubrication of the stacker shall be called upon to work. Adequate hand holds and foot holds shall be provided where necessary. Hand holds and access opening shall be as per relevant Indian Standard(s) where available.

6.3 Every platform shall be securely fenced with double tiered guard rails having a minimum height of 1.1 m and toe boards unless parts of the stacker structure provide safety. The platform shall be of sufficient width to enable normal maintenance work to be carried out safely. On bridge platform which shall not be less than, 0.75 m in width the hand rails shall be provided along the full length of the stacker boom. A toe plate shall be provided on all platforms to prevent rolling down of materials from platforms.

6.4 Ladders

Sides of the ladders shall extend to a reasonable distance above the platforms or other reliable hand holds shall be provided. Ladders shall, if possible, slope forward. Vertical ladders, exceeding 3 m in length, shall be provided with safety cages.

7 DISCHARGE MECHANISM

7.1 Discharge chute shall be provided with required liner plates.

7.2 Adequate care shall be taken to avoid fouling of the discharge chute with skirt board provided on the boom conveyor during luffing motion.

7.3 Suitable liner(s) shall be provided for handling, respective material inside the discharge chute.

8 PRESSURISATION AND DUST COLLECTION

8.1 Pressurisation

Operator's cabin shall be pressurised to prevent ingress of dust. Pressuring system shall be provided to create a pressure of 5 mm water gauge and 15 air changes per hour in the machinery house and operator's cabin. All electronic controls provided shall be housed in an airconditioned space.

8.2 Dust Control System

8.2.1 The dust control system shall be capable of collecting completely the dust which is raised from the receiving chute and material transfer points but excluding the discharge point of the stacker. Facility shall be provided to convey the dust collected to the ultimate material discharge point.

8.2.2 Maximum permissible dust loading from the system shall not be more than 25 mg/m^3 or the minimum statutory provisions for pollution control whichever is less. Protection against fire hazard shall be provided for the dust collection system when handling hazardous materials.

9 SAFETY REQUIREMENTS

9.1 The slewable stacker shall comply with the relevant safety regulations under the *Factories Act*, 1948, Indian Electricity Rules and other Statutory Regulations, Rules, Acts, etc, as applicable.

9.2 Following essential safety features shall be specifically provided:

- a) Fire extinguisher and smoke detector alarm system,
- b) Buffers,
- c) Limit switches,
- d) Anemometer,
- e) Safety interlocking,
- f) Rail clamps and anchoring devices,
- g) Audio visual alarm, and
- h) Guards and cages.

10 LUBRICATION

10.1 Provision shall be made for lubricating all bearings which shall be easily accessible from the working platforms of the stacker. Centralized

lubrication system conforming to IS 8593 (in three parts) shall be preferred.

10.2 If deemed necessary, provision shall be made at the bearings to vent excess lubricant pressure.

10.3 Lubricating nipples, pipes and adapters shall generally comply with relevant Indian Standards.

10.4 A lubricating chart shall be provided indicating all the lubricating points, the type of lubricant and recommended frequency of lubrication.

11 POWER FEEDING ARRANGEMENTS

11.1 Power feeding to the ship loaders shall be through cable reeving drums (CRD) with trailing cable arrangements. Separate drums for power and control cables shall be provided. The feeding of the cables to CRD shall be properly guided through cable guides to prevent the trailing cable from falling on the track rails or getting entangled with fixed structures. Cable tray may be provided below the CRD along its path to prevent cable lying on the ground. However, the provision of cables tray system shall be optional and is not required in case level ground/floor is available below CRD for each cable to lie.

11.2 Safety limit switches/devices to prevent over stretching of cable at the feeding point on the ground shall be provided.

12 WEATHER PROTECTION AND PAINTING

12.1 All electrical, structural and mechanical equipment shall be adequately protected from weather. All weather proof covers shall be easily removable.

12.2 The stacker shall be provided with two coats of anti-corrosive primer after suitable surface preparation and final two coats of finish paint to suit the operating and environmental conditions as specified by purchaser.

13 LOAD TESTS

13.1 Prior to being placed in service, the stacker shall be tested under overload conditions as given in 13.1.1 and 13.1.2.

13.1.1 Dynamic Test

The dynamic test shall be carried out with a load of 120 percent of the safe working load. All motions shall be carefully operated in turn, without checking speeds or temperature rises in the motors.

13.1.2 Static Test

The static test shall be carried out with a load equal to 140 percent of the safe working load. This test shall be carried out under still conditions and

consists of hoisting the safe working load to small distance above the ground and then adding the required surplus without shock.

NOTES

1 The values given for these test loads represent minimum requirements. Where Legislation/Rules or any other statutory Acts or Requirements call for higher values, these shall be complied with.

2 When making these tests, it is customary to measure the deflection of the structure of an unloader. In case, the user wishes to impose a deflection limit, he shall specify this in his call for tender/enquiry.

13.2 Acceptable Tolerances

Acceptable tolerances on trolleys, and tracks shall be as given in 13.2.1 to 13.2.13.

13.2.1 The trolley rail-centre distance's shall not differ from the nominal dimension by more than ± 3 mm as shown in Fig. 1.

13.2.2 The difference in height of two opposite points of the trolley track perpendicular to the travel direction of the trolley shall not exceed 0.15 percent of the trolley rail-centre distance, with a maximum of 10 mm as shown in Fig. 2.

13.2.3 Trolley rails shall be laid in a way that the running surface perpendicular to the direction of the rail is horizontal and that the greatest unevenness of the bearing surface is not more than ± 3 mm for rail-centres upto 3 m as shown in Fig. 3.

13.2.4 The centre of the trolley rail shall not diverge from the centre of the rail girder web by more than half the thickness of the rail girder web as shown in Fig. 4.

13.2.5 For lateral straightness of trolley rail, the centre axis of the trolley rail shall not diverge from the theoretical centre axis of the rail by more than ± 1.0 mm on a rail length of 2 m. There shall be no misalignments at rail joints (see Fig. 5).

13.2.6 The axis of the wheel axle bores shall be within an angular deviation in the horizontal plane of ± 0.04 percent from its theoretical position (see Fig. 6).

13.2.7 The axle bores of the wheels opposite to each other and if wheels are mounted in bogies, the axis of the bogies pins of the unwarped trolley and unloader bridge shall have an alignment divergence in the vertical plane, less than 0.15 percent, maximum 2 mm of the trolley wheel centre distance (see Fig. 7).

13.2.8 The centres of wheels rolling on a common rail shall not diverge more than ± 1 mm from the rail centre (see Fig. 8).

13.2.8.1 For bushed wheels the above tolerances apply with the wheels in a central position between the wearing plates at either side of the wheel boss.

13.2.9 If horizontal guide rollers are used, the centre of the distance between guide rollers at one corner shall not deviate more than ± 1 mm from the centre axis of the rail (see Fig. 9).

13.2.10 The diameter tolerance of the wheel shall correspond to 'h9' as per IS 919 (Part 1) : 1993.

13.2.10.1 If runner wheel speeds are synchronized by an electrical shaft, tighter tolerances may be required. These shall have to be determined from case to case.

13.2.10.2 The above tolerance apply to non driven wheels also as the wheels shall have to be interchangeable.

13.2.11 Recommended tolerances for unloader tracks are given below. These tolerances apply to new unloader tracks. If, in the course of use, these tolerances are exceeded by 20 percent, the track shall be re-aligned. In case the travelling behaviour is noticeably deteriorating, it may be necessary to re-align the track; even if the tolerance excess has not reached 20 percent.

The greatest divergence ' Δs ' from the span ' s ' in metres is:

$$\text{for } s \leq 15 \text{ m : } \Delta s = \pm 3 \text{ mm}$$

$$\text{for } s < 15 \text{ m : } \Delta s = \pm [3 + 0.25 (s - 15)] \text{ mm} \\ (\text{maximum } \pm 25 \text{ mm})$$

13.2.11.1 If horizontal guide rollers are provided on one rail only, the tolerances for the other rail only (rail without guide rollers) may be increased to three times the above values, but shall not exceed 25 mm.

13.2.11.2 It is assumed that with the trolley positioned in the centre of the span the deflection of both rail tracks shall be approximately equal.

13.2.11.3 The greatest permissible tolerance of the upper edge of the rail shall be ± 10 mm from the theoretical height position. The theoretical height is either the horizontal position or if applicable, the theoretical camber curve. The height position of the two rails may show a divergence of 10 mm. The curvature in a longitudinal direction may, at each point of a measured length of 2 m, not exceed a rise of ± 2 mm.

13.2.12 The inclination of the rail rolling surface shall not exceed the following values as compared with the theoretical position (see Fig. 10):

Longitudinally : 0.3 percent
Laterally : 0.3 percent

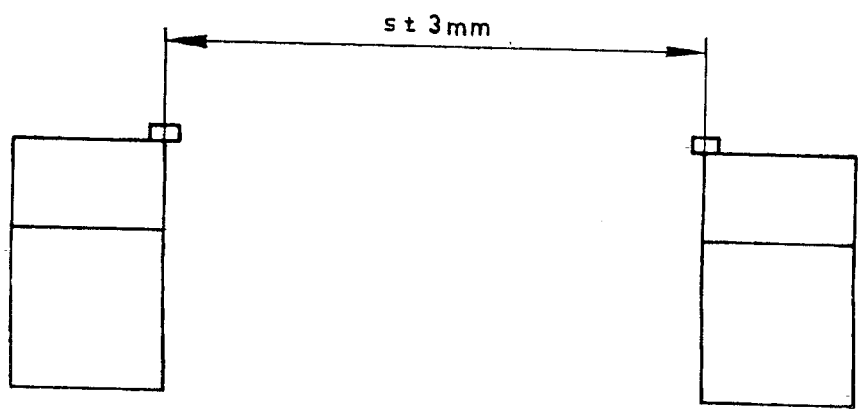


FIG. 1 TROLLEY RAIL DISTANCE

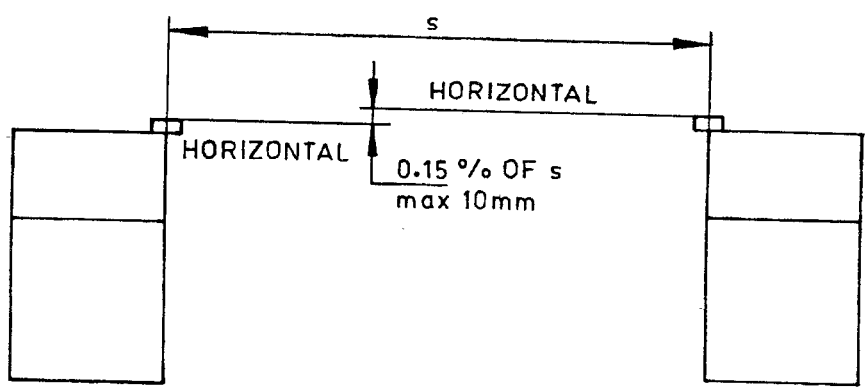


FIG. 2 HEIGHT DIFFERENCE OF TROLLEY

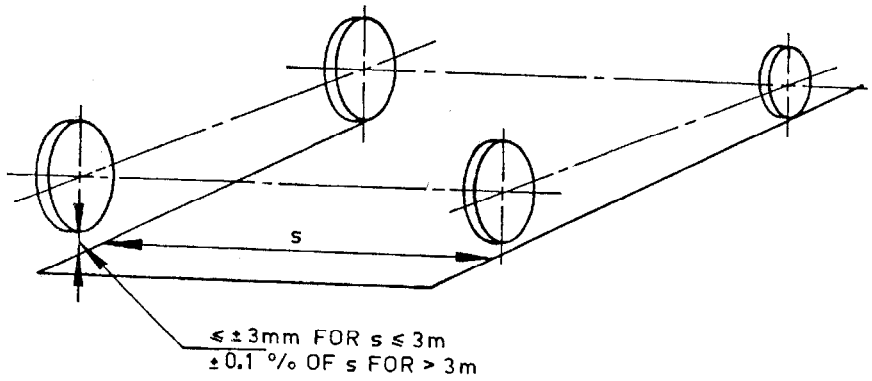


FIG. 3 RUNNING SURFACE OF TROLLEY RAILS

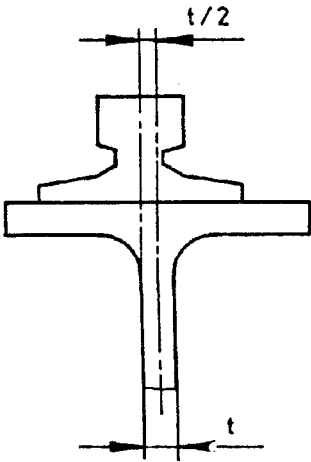


FIG. 4 CENTRE OF TROLLEY RAIL

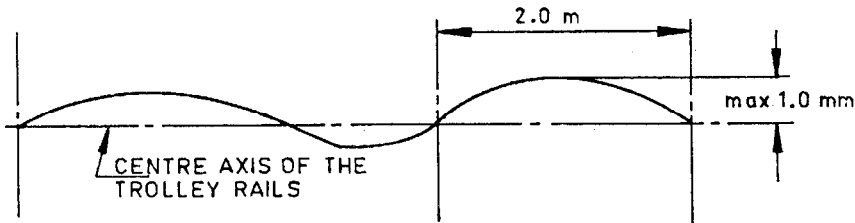


FIG. 5 LATERAL STRAIGHTNESS OF TROLLEY RAIL

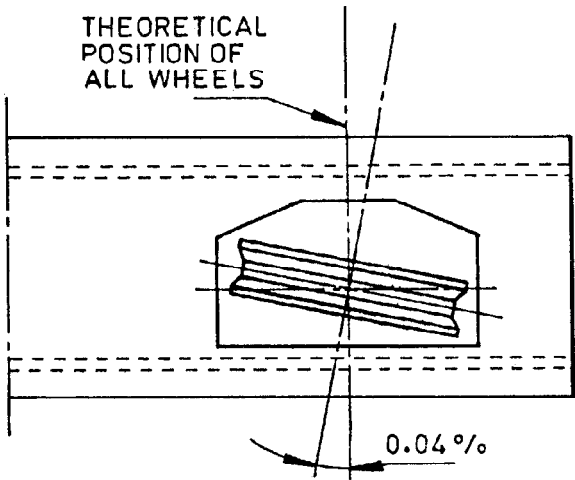


FIG. 6 AXIS OF WHEEL AXLE BORES

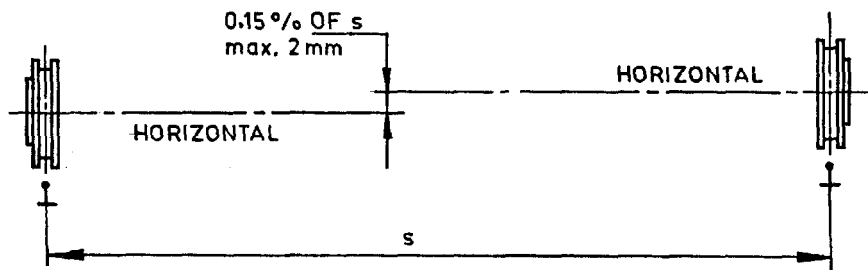


FIG. 7 AXLE BORES OF WHEELS

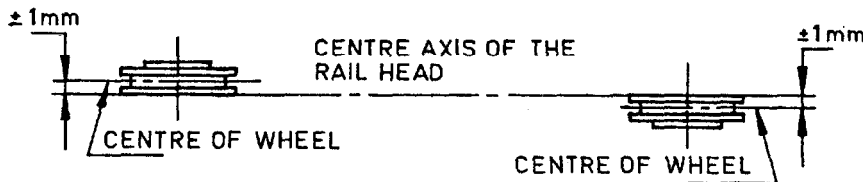


FIG. 8 CENTRES OF WHEELS OF SAME RAIL

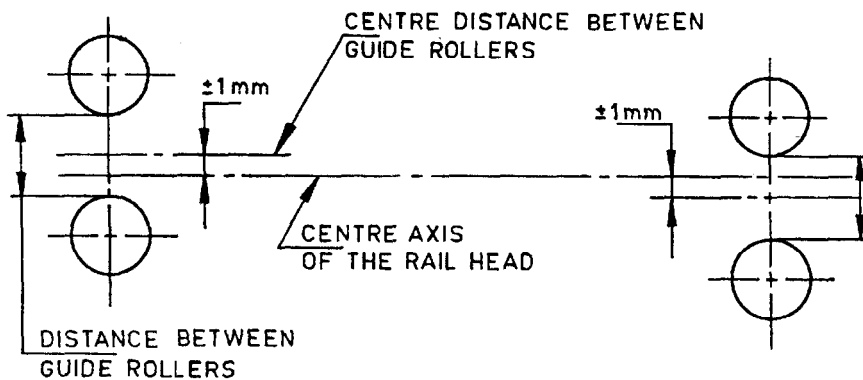


FIG. 9 CENTRE DISTANCE BETWEEN GUIDE ROLLERS

13.2.13 For the total length of rail, the maximum lateral tolerance from a straight line shall be $\pm 10\text{ mm}$. The curvature at the longitudinal rail axis in a horizontal direction shall not exceed a lateral deviation of $\pm 1\text{ mm}$ measured at 2 m rail length (see Fig. 11).

13.2.13.1 For unloaders guided on both sides by horizontal rollers, the above values shall be valid for the rail surfaces of the horizontal rollers.

13.2.13.2 For unloaders guided on one rail only, the requirement for the straightness of the non-guiding rail may be lowered.

13.2.14 For the values in 13.2.1 to 13.2.13, no account has been taken for misalignment at the rail joints. It is recommended to use welded rail joints.

SECTION 2 ELECTRICAL REQUIREMENTS

14 GENERAL

14.1 The stacker shall be complete with all electrical accessories required for its safe, smooth and efficient operation.

14.2 Only non-hygroscopic materials shall be used for insulation.

14.3 Electrical system offered shall be suitable for the power supply system fault level at that point.

14.4 Electrical installation work shall be carried out through licensed electrical contractors, holding valid contractor's licenses issued by the concerned Statutory Authority and also conforming to relevant standards of individual electricals located in the machine.

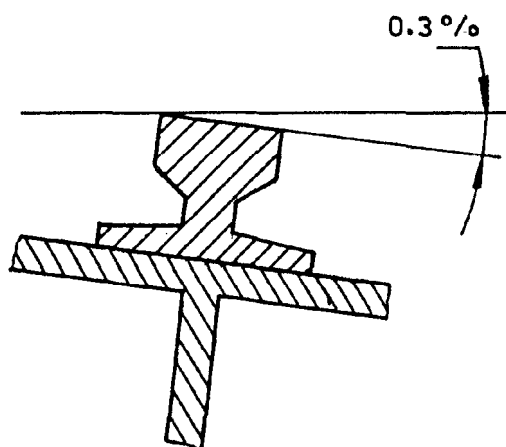


FIG. 10 INCLINATION OF RAIL

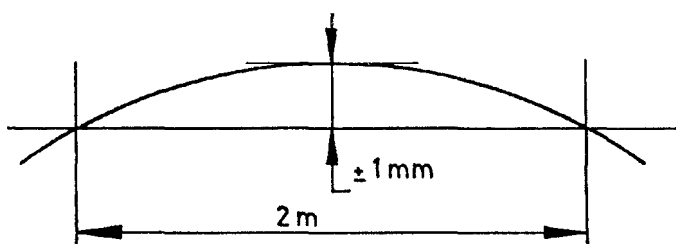


FIG. 11 TOLERANCE ON TOTAL LENGTH OF RAIL

14.5 All electricals shall be mounted on anti-vibration pads.

15 ENCLOSURES

15.1 All electrical equipment shall be properly enclosed or protected to suit the environmental conditions and to prevent inadvertent or accidental contact.

15.2 All enclosures shall preferably be of cast iron or cast aluminium. Wherever sheet steel has to be used, the thickness of the metal shall not be less than 2 mm where enclosures are housed inside a covered area. All exposed outside panels shall have a metal thickness of not less than 3.15 mm.

15.2.1 All joints in enclosures shall be made dust-proof by gaskets of high quality non-deteriorating rubber or other suitable material.

15.3 Bare conductors, if used as bus wires, shall be located so as to prevent any form of accidental contact. The execution shall ensure complete safety and wherever necessary, metallic screens shall be employed.

15.4 Flame proof/increased safety enclosures shall be provided for electrical equipments wherever required.

15.5 Wherever it is necessary for an electrical equipment to be adjusted or inspected while in

service, necessary clearances from live parts may be provided to ensure safety in operation.

15.6 All enclosures of electrical equipments shall be given two coats of anticorrosive epoxy paint over two coats of primer suitable for epoxy.

15.7 Various control gears like contactors, relays, control transformers, etc, shall be housed in dust proof, damp proof and vermin proof protective panels having doors interlocked with the supply control switches. Space heaters shall be provided for the panels.

16 POWER SUPPLY ARRANGEMENTS

16.1 Power supply shall be controlled by a circuit breaker from which power shall be taken to the stacker through suitable collector systems such as cable reeling drum, etc.

16.2 It shall be possible to trip the circuit breaker from the machinery house of the stacker.

16.3 Circuit breaker to isolate the main supply to the stacker shall be provided. It shall be possible to switch off this breaker from the operator's cabin.

16.4 A plug and socket arrangement shall be provided to connect up the stacker's current collecting arrangements (power and control).

16.4.1 In case of plug and socket arrangement, power socket shall be interlocked so that the plug can be withdrawn only when the circuit breaker/isolating switch is 'OFF'.

16.5 External control links shall be taken out of the stacker using a current collection system similar to that for power. This system may carry the communication links also.

17 POWER TRANSFORMERS

Power transformers if provided shall be dry type. These shall have overload, voltage and temperature protection.

18 MOTORS

18.1 To select a motor, the following shall be established:

- a) The maximum torque required to produce motion in the most unfavourable case.
- b) That it shall allow the stacker to perform its normal duty without abnormal wear.

18.2 A.C. motors shall be of totally enclosed, fan-cooled weather protected, hose-proof design (IP-55 degree of protection) with at least class B insulation and shall be suitable for crane duty.

18.2.1 A.C. motors shall have overload and short circuit protection.

18.3 D.C. motors shall have at least IP-23 enclosure for indoor duty and IP-55 enclosure for outdoor duty.

18.4 The motor shall have at least the following cyclic duty factors:

Trolley travel	60 percent
Other motions	40 percent

18.4.1 Motors shall have built-in thermistors with alarm, and shall have space heating elements, either heating or space heater elements, as specified.

18.5 Thyristor drives if provided shall have current limitation, speed limitation, overload protection, short circuit protection and fuse protection and preferably rated for Class 4.

19 RESISTORS

Resistors if provided, shall be intermittent rated for Class 4 duty and shall be suitable for the climatic conditions and the corrosive atmosphere described elsewhere. Stainless steel resistance grids shall be preferred.

20 CABLES

20.1 All power cables shall be PVC insulated, armoured and PVC sheathed, flexible type preferably with copper conductor. However trail-

ing cables shall have copper conductors only. All control cables shall be 2.5 mm² copper.

20.2 Power and control cables shall be protected with HRC fuses/circuit breakers.

20.3 The sizes of the cables shall be so chosen that they are rated to carry the full load current continuously after allowing for necessary derating factors for the conditions of installation, and also so that the voltage drop in cables shall not exceed 3 percent during running.

20.4 All cables shall be neatly clamped at suitable intervals.

20.5 All cables shall be terminated by suitable cable glands.

20.6 Metallic conduits shall be provided wherever necessary for the protection of the cables.

20.7 Power and control cables to the operator's cabin shall be provided with a loop to take care of movement of cabin during luff operations.

20.8 Electrical circuits may be printed/painted/pasted at the inside of control panel covers.

21 EARTHING

21.1 The stacker shall be earthed through shoes rubbing on the rails. In addition, the connection between the circuit breaker and the stacker shall have a fourth conductor to be used as an earth connection. The earth connection shall be linked to the earth connection of the main circuit breaker.

21.2 Double earthing shall be provided for all equipments.

22 LIGHTING

22.1 The stacker shall be provided with suitable illumination to ensure good lighting at all places.

21.2 Flood lights shall be provided at the following points:

- a) On the apron for the operator to see the operation during the night.
- b) In front and rear portions of the stacker to properly light the tracks during stacker travel in the night.

22.3 All lighting circuits shall be protected with HRC fuses and shall be controlled by one main switch-fuse in addition to separate circuit control switches.

22.4 Battery operated emergency lights shall be provided at strategic locations. These shall be the automatic type. The light shall automatically come 'ON' when normal power supply fails and shall go

'OFF' automatically when normal supply comes back. The unit shall incorporate a trickle charger for keeping the battery on charge. The battery shall be rated for at least 30 minutes operation.

22.5 Air-craft warning/aviation lights shall be provided on the stacker if required by any Statutory Authorities for which separate battery units with chargers shall be provided.

22.6 All light fittings shall be mounted on shock absorbers.

22.7 Low voltage (24V) plug socket outlets, with hand lamps and sufficient lengths of cables, shall be provided.

23 CONTROLS

A safe low voltage shall be employed for the controls. This shall be from the secondary winding of an isolating transformer; one terminal of this supply shall be earthed and the contactor and the relay coils shall be connected to this terminal.

24 INTERLOCKS

24.1 Necessary interlocks for the safe and smooth operation of the stacker shall be provided.

24.2 'Forward' and 'Reverse' contactors shall be interlocked electrically, and preferably mechanically as well.

25 PROTECTION

25.1 In case of wind speed beyond preset level, an audio-visual alarm shall be given in operator's cabin to enable the operator to stop the operation of the machine. If the operation is not stopped, automatic cut-off of power supply shall be effective beyond a preset higher wind speed.

25.2 Shunt and series limit switches shall be provided for all motions. The shunt switch shall operate first and if the motion fails to stop, series limit switch shall act. Additional limit switches shall be provided for long travel, trolley travel, cabin travel, etc.

25.2.1 Instead of shunt and series limit switches, mechanical endlimit switches may be provided. The pre-limit switch shall act first to trip the motor end-limit switch, the breaker on the secondary side of the transformer shall get tripped. For the trolley an additional pre-limit switch shall be provided ahead of the two limit switches mentioned above.

25.3 Phase failure relay shall be provided to trip the main circuit breaker.

25.5 A warning audio alarm shall be given automatically during long travel operation.

26 AIR CONDITIONING

In the interest of long life and reliable operation, electronic components and other components sensitive to temperature, humidity and dust, shall preferably be located in air-conditioned space(s).

27 LIFT

An electrically operated lift is recommended.

28 COMMUNICATION FACILITIES

Inter-communication facility within the stacker structure is recommended.

29 AUTOMATION

Where considered essential, automation may be provided to reduce physical and psychological stress of operator. Provision shall be kept for overriding automation.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
919 (Part 1) : 1993	ISO system of limits and fits: Part 1 Basis of tolerances, deviations and fits (<i>second revision</i>)	1367 (Part 5) : 1980	Technical supply conditions for threaded steel fasteners: Part 5 Mechanical properties and test methods for set screws and similar threaded fasteners not under tensile stresses (<i>second revision</i>)
1136 : 1958	preferred sizes for wrought metal products		
1364 (Part 1) : 1992/ ISO 4014 : 1986	Hexagon head bolts, screws and nuts of product grade A and B : Part 1 Hexagon head bolts (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 6) : 1994/ ISO 898-2 : 1992	Technical supply conditions for threaded steel fasteners: Part 6 Mechanical properties and test methods for nuts with specified proof loads (<i>third revision</i>)
1364 (Part 2) : 1992/ ISO 4017 : 1988	Hexagon head bolts, screws and nuts of product grade A and B : Part 2 Hexagon head screws (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 7) : 1980	Technical supply conditions for threaded steel fasteners: Part 7 Mechanical properties and test methods for nuts without specified proof loads (<i>second revision</i>)
1364 (Part 3) : 1992/ ISO 4032 : 1986	Hexagon head bolts, screws and nuts of product grade A and B : Part 3 Hexagon nuts (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 8) : 1992	Technical supply conditions for threaded steel fasteners: Part 8 Mechanical and performance properties for prevailing torque type steel hexagon nuts (<i>second revision</i>)
1364 (Part 4) : 1992/ ISO 4035 : 1986	Hexagon head bolts, screws and nuts of product grade A and B : Part 4 Hexagon thin nuts (chamfered) (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 9/Sec 1) : 1993 / ISO 6157-1 : 1988	Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities Section 1 Bolts, screws and studs for general applications (<i>third revision</i>)
1364 (Part 5) : 1992/ ISO 4036 : 1979	Hexagon head bolts, screws and nuts of product grade A and B : Part 5 Hexagon thin nuts (unchamfered) (size range M1.6 to M10) (<i>third revision</i>)	1367 (Part 9/Sec 2) : 1993 / ISO 6157-3 : 1988	Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities Section 2 Bolts, screws and studs for special applications (<i>third revision</i>)
1367 (Part 1) : 1980	Technical supply conditions for threaded steel fasteners: Part 1 Introduction and general information (<i>second revision</i>)	1367 (Part 10) : 1979	Technical supply conditions for threaded steel fasteners: Part 10 Surface discontinuities on nuts (<i>second revision</i>)
1367 (Part 2) : 1979	Technical supply conditions for threaded steel fasteners: Part 2 Product grades and tolerances (<i>second revision</i>)	1367 (Part 12) : 1981	Technical supply conditions for threaded steel fasteners: Part 12 Phosphate coatings on threaded fasteners (<i>second revision</i>)
1367 (Part 3) : 1991/ ISO 898-1 : 1988	Fasteners — Threaded steel — Technical supply conditions: Part 3 Mechanical properties and test methods for bolts, screws and studs with full loadability (<i>third revision</i>)		

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
1367 (Part 13) : 1983	Technical supply conditions for threaded steel fasteners: Part 13 Hot-dip galvanized coatings on threaded fasteners (<i>second revision</i>)	5372 : 1975	cranes other than steel work cranes Taper washers for channels (ISMC) (<i>first revision</i>)
1367 (Part 14) : 1984	Technical supply conditions for threaded steel fasteners: Part 14 Stainless steel threaded fasteners (<i>second revision</i>)	5374 : 1974	Taper washers for I-beams (ISMB) (<i>first revision</i>)
1367 (Part 16) : 1979	Technical supply conditions for threaded steel fasteners: Part 16 Designation system and symbols (<i>second revision</i>)	8593 (Part 1) : 1977	Recommendations for centralized lubrication as applied to plant and machinery: Part 1 Oil lubrication
1367 (Part 18) : 1979	Technical supply conditions for threaded steel fasteners: Part 18 Marking and mode of delivery (<i>second revision</i>)	8593 (Part 2) : 1988	Recommendations for centralized lubrication as applied to plant and machinery: Part 2 Grease lubrication
2016 : 1967	Plain washers (<i>first revision</i>)	8593 (Part 3) : 1984	Recommendations for centralized lubrication as applied to plant and machinery: Part 3 Aerosol lubrication
2266 : 1989	Steel wire ropes for general engineering purposes (<i>third revision</i>)	11592 : 1985	Code of practice for selection and design of belt conveyors
3177 : 1977	Code of practice for overhead travelling cranes and gantry	13148 : 1991	Bulk handling equipment — Mobile continuous type — Rule for design of structures

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Amendments Issued Since Publication

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